The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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Sulphur

SULPHUR is an element which, particularly in combination with other elements, is exceedingly useful in the right place, but is apt to prove disastrous in the wrong place. Not for nothing was sulphur regarded by the alchemists as the " male element," the " Adamic earth," one of the three constituents of the Philosopher's Stone. They expended a lot of time upon its reactions and a surprising amount of ingenuity to-day is devoted to bringing sulphur from the wrong place to the right place. Mr. Parrish, in his address to the London Section of the Society of Chemical Industry upon recent advances in sulphuric-acid manufacture, gave many facts relating to the latest devices employed in performing this operation. When one comes to think about it, sulphur is nearly always in the wrong place. In pyrites, as any coal miner will agree, it is an impurity that requires a good deal of trouble to eliminate even partly. In coal gas, or coke-oven gas, its presence is anathema to any self-respecting gas engineer or metallurgist. It must be removed with exceeding care from the zinc ores with which it is so largely combined in nature. The modern power-station engineer has been brought to look askance upon sulphur in his exit gases, and so may all large users of fuel in due season. The Alkali Inspector regards the escape of even traces of sulphur from chemical works with extreme disfavour. The problem of how to get the sulphur into the right place is one of some complexity.

The " right place " also involves consideration of the right form in which the sulphur is to be available. It is evident from Mr. Parrish's discourse that elemental sulphur is to be preferred to combined sulphur. There are many uses in chemical industry for brimstone sulphur; one need only instance the use of sulphur for spraying in agriculture, the manufacture of carbon disulphide or the vulcanisation of rubber. Even the sulphuric-acid maker prefers brimstone to-day partly because of its freedom from arsenic and its purity, and partly because automatically-controlled burners can operate on molten sulphur or on the solid. As far as possible, therefore, sulphur should be recovered in this form. For this purpose, unfortunately, there are available only such processes as the old Claus kiln or the Thylox and Katasulph processes, which have a limited application and of which there is no experience as yet in this country. These processes are for the recovery of hydrogen sulphide from coal gas or from saturator gases. Mr. Parrish showed that the oxide process can be so operated as to yield an oxide with 45 per cent. sulphur, 8 to 10 per cent. organic matter and 0.5 per cent. tar, but that with careless operation the spent oxide may contain up to 5 per cent. tar and 6 per cent. ammonia in addition to quantities of organic matter, which render it much less suitable for the nitration process and virtually useless for the contact process.

Pyrites could be recovered from the refuse of coal washeries if the collieries could be persuaded to instal the necessary plant. Probably some 50,000 tons of this material could be recovered, sufficiently concentrated for use in many processes. The sulphur is now being recovered from zinc ores. Very little sulphur is as yet recovered from coke-oven gas because the price obtained for the sulphur is not sufficiently high to enable the operation to be conducted at a profit, unless there are other considerations. Metallurgists agree that for all operations in which the gas or its products of combustion come into contact with steel, coke-oven gas should be purified from sulphur. Unfortunately the commercial men of the steel industry will not agree to pay for the small extra cost involved and this shortsighted policy is losing the country very large amounts of sulphur and is causing the wastage of unnecessarily large quantities of steel.

Dr. Lessing foreshadowed an important development in the recovery of sulphur in the form of ammonium sulphate from the chimney gases of gas works and coke ovens through the agency of calcium sulphate followed by total decomposition. As the process appears to be the most satisfactory attempt yet to utilise sulphur in fuel directly for the production of sulphate of ammonia, we hope that he will soon be in a position to disclose more details of this process. The recovery of sulphur from power-station boiler gases and from other industrial plants not concerned with the carbonisation of coal is another phase of the problem to which attention should be devoted. It is clear that the production of sulphate of ammonia would not be a satisfactory solution because the existing markets are already over-supplied. The key appears to lie in the production of elemental sulphur, the popularity of which is increasing so rapidly. There are absorption processes of some promise by which the sulphur dioxide can be concentrated, after which it can be reduced by highly heated coke. We may burn 50 million tons of coal annually in installations large enough to recover the sulphur if a sufficiently simple process could be devised. Even with incomplete recovery, the astonishing total of half a million tons of sulphur would be available from this source annually. As the sulphur used in our sulphuric acid production is only of this order of magnitude it is evident that we might soon be within sight of self-sufficiency.

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NOTES AND COMMENTS

Rayon Export Drive

AS indicated in our last week's issue, from information received as we went to press, a new venture in export trading is about to be launched by the Rayon Export Group. The group is to establish a company, to be known as the Central Rayon Office, the aim of which will be to secure maximum output at minimum economic cost, an objective that can best be attained by co-operation and co-ordination within the industry as a whole. The company will be limited by guarantee and will be without share capital. Its headquarters will be at Manchester. Sir Percy Ashley, who, as already stated, will be chairman, is also Cotton Controller and chairman of the Rayon Export Group. He will be assisted in directing the policy and activities of the company by members of the executive committee of the group. The company will organise and initiate trading methods suitable for a war-time export drive and the exigencies of post-war international trade. It will eliminate competition within the trade. Mr. R. Huntley-Davidson, secretary of the group, has announced that the task before the trade was to recover in the form of rayon and rayon mixtures a substantial proportion of the trade in cottons which had been lost in recent years to foreign producers. Activities of the company will include the arranging of production of standardised lines, and full encouragement of the initiative of manufacturers, dyers, shippers, etc., to secure maximum efficiencies and economies with equitable and proportionate margins for each section, and of suggestions for qualities offering scope for new volume business.

Witherite in Coal Seams

AN interesting piece of information contained in the recent Fuel Research Board Report is that half the world demand for witherite ($BaCO_3$) is supplied from the Morrison North pit of the Holmside and South Moor Collieries, Ltd., where the witherite occurs in a nearly vertical fault fissure which has been proved down to the deepest workable coal seam. A large quantity of water has been met in the vein and has been found to contain up to 10 gm. of barium bicarbonate per gallon. Probably as a direct consequence of its contact with this water, the coal in all seams in the immediate proximity of the witherite vein contains barium carbonate, one sample containing as much as 3 per cent. Witherite has also been mined from the Craghead Busty pit, of the same company, a few miles from, and in a fault parallel to, the main Holmside deposit. A mixed calcite and witherite deposit containing a little barytes occurs in a vein, 6 ft. thick in places, at another colliery a few miles away. It has been learned that strontium has been found in coal from the Brockwell seam, whitish incrustations on the coal having been identified as strontianite, but it is considered that the amount of strontium in the seam is insufficient to justify mining for this element specially. Many other elements which are present in coal to a very considerable extent are proving of industrial importance either because they represent undesirable impurities or for other reasons. The importance of arsenic is well known, but fluorine, boron, germanium, titanium, and nickel have all been found during the work of the Coal Survey and are considered important in connection with certain of the uses of coal.

Searching the Literature

ANYONE who has conscientiously made a search in "the literature" will heartily agree with Mr. Lancaster Jones when he writes that there is no easy and facile way through the complex literature of science. But all scientists should be deeply indebted to him for his paper, entitled "Searching the Literature of Science," which appears in the current issue of the *Journal of Scientific Instruments*. Though Mr. Jones, himself one of the guiding spirits of the admirable Science Library at South Kensington, cannot give us a panacea for all our literary troubles, yet he can and does provide some extraordinarily useful guidance on how to set about the solution of such problems. In the first place he calls attention to the Universal Decimal System of card-cataloguing, which puts searchers on the right track; further, he reminds us of the work of such helpful authors as Minto and Holmstrom and the American compilers of the Bibliographic Index. But he warns the searcher that he must be prepared to "tap judiciously" the various guides, remembering that any guide must be selective, not exhaustive, and also—an important point—quickly obsolescent. In fact, as in every other problem in science, the searcher who takes trouble will get his reward. We can profit by the labours of previous workers in the same field, but ultimately it is by our own independent efforts that we arrive at the desired goal.

The Restoration of Our Liberties

LAST August we called attention in these columns to the Prime Minister's pledge to wipe out war restrictions the moment that victory arrived. That pledge, as we reported at the time, was given to us through the mouth of Sir Archibald Sinclair and the medium of the microphone, and in commenting upon it we expressed the view that "when Parliament reassembles he (the Prime Minister) will no doubt take an opportunity of confirming his promise personally and from the orthodox position of the Treasury Bench." Our hope has been justified, and Mr. Churchill, speaking in the House of Commons on Thursday of last week, not only repeated the terms of the pledge as reported by Sir Archibald Sinclair, but strengthened its terms. We quote his words as summarising in the most complete and authoritative manner all that has been said on this vital matter in our own columns. This is what Mr. Churchill said: "Immense surrenders of their hard-won liberties have been voluntarily made by the British people in order in time of war to serve the better the cause of freedom and fair play to which, keeping nothing back, they have devoted all that they have and all that they are. Parliament stands custodian of these surrendered liberties, and its most sacred duty will be to restore them in their fulness when victory has crowned our exertions and our perseverance."

REMOVAL AND RECOVERY OF SULPHUR FROM SMELTER GASES, I

Absorption of Sulphur Dioxide

by D. D. HOWAT, B.Sc., A.Inst.M.M., A.I.C., Ph. D.

RESEARCH has been carried out for many years on the removal of entrained dust and substances dangerous both to human health and to vegetation from the gases produced in smelters. The removal and subsequent disposal of sulphur, arsenic and entrained dust has presented considerable problems. Dust and arsenic, existing as a condensible vapour, may be effectively removed by the use of long baffled flues, washing machines or electrostatic precipitators. Sulphur, probably the most commonly occurring non-metallic element in ores, is oxidised almost entirely to sulphur dioxide in normal smelting conditions, and for a long time the simplest way of disposing of gases containing sulphur dioxide was to discharge them to the atmosphere in a more or less diluted condition through a tall stack. This procedure was not by any means a satisfactory solution as it did not deal effectively with the deleterious action of the sulphur dioxide on agricultural land, forestry schemes, or human or animal health. It did not eliminate the frequent lawsuits in which the smelting companies found themselves involved, nor did it stop the wastage of a substance of considerable economic value. Calculations showed that in the year 1929 the wastage of sulphur in smelter gases was over 2½ million tons, while the production of natural sulphur from the deposits in Texas and Sicily was about 2,800,000 tons, so that the wastage was just about equal to the world supply of natural sulphur, constituting about one-third of the total sulphur used in any form.

Three Methods of Treatment

From time to time three different methods have been suggested for utilising the waste gases and recovering the sulphur. The oldest and simplest method was the production of sulphuric acid, utilising either the old "chamber process" or the more modern "contact process." Another hopeful line of attack was the development of methods of separating the sulphur dioxide from the gases and liquefying the concentrated product, while within the past few years the use of smelter gases for the production of elementary sulphur has given promise of being an important industry. All three methods of treatment have attendant disadvantages. For the production of sulphuric acid, gases with a high sulphur dioxide content were required, and this ruled out the possibility of treating the gases produced in lead smelting, which carry only a low sulphur content. The handling and transport of the acid presented acute problems which were further accentuated by the fact that practically all the smelters were at great distances from markets with a demand for acid. To a certain extent the same considerations apply in the case of liquid sulphur dioxide, storage, handling and transport again constituting formidable obstacles to the development of the industry. In a country such as Finland, where a 50-ton-per-day plant has been in operation for a few years, a ready market exists for sulphur dioxide in the paper pulp industry and this method of utilisation has been followed with success. Undoubtedly the most convenient method of all is the production of elementary sulphur. Two disadvantages are encountered: the product must compete in price with the natural sulphur from Texas, Sicily, and other sources; and the capital cost of the necessary plant is high. It is claimed in modern practice that the costs of production are such that at the present price of sulphur a reasonable return may be obtained on the expenditure required for the plant.

The difficulties experienced during the present war conditions in obtaining sufficient supplies of sulphur may indicate a greater importance for this method. Certain of the processes developed for the treatment of smelter gases have given promising results when applied to the removal of sulphur from boiler-flue gases. Developments along such lines may assist in supplementing the supplies of sulphur available.

In this article attention is directed to the removal of sulphur from smelter gases either for the production of liquid sulphur dioxide or of elementary sulphur.

As a preliminary to the recovery of the sulphur it is frequently necessary to treat the smelter gases with some suitable absorbent in which the sulphur dioxide becomes concentrated; the gas being liberated in some subsequent step, the absorbent regenerated and returned to the scrubbers. In one report from the U.S. Bureau of Mines[26] it is stated that no satisfactory results have been obtained without this preliminary concentration of the sulphur dioxide. But the process developed at Rönnskär, Sweden, by the Boliden Mining Co. does not include this step, the raw smelter gases being treated directly for the reduction of sulphur dioxide to elementary sulphur. From this plant an annual output of about 25,000 tons of sulphur is being maintained.

A great volume of patent literature exists relating to the different methods of sulphur dioxide absorption from smelter gases, but it may be said that three types of absorbents have proved suitable for application on a commercial scale.

The use of aqueous solutions of ammonium sulphite and bisulphite has been adopted by the Consolidated Mining and Smelting Co. of Canada at their British Columbia plant. I.C.I., Ltd., have developed the use of aqueous solutions of basic aluminium sulphates while the Swiss firm, Chemische Industrie Basle (Ciba), in conjunction with Metallgesellschaft A.G. of Frankfurt-am-Main, practise absorption in aqueous solutions of organic amines. Further research and small scale pilot-plant work has been carried out on the use of solutions of sodium sulphite and bisulphite and of aliphatic short-chain amines.[26, 13, 14, 15, 16, 17, 18, 7] A suggestion has also been made[24] to use the ammonium or sodium salt of an organic acid with low solubility at 20-25° C. and high solubility at 100° C., benzoic, fumaric, phthalic or salicylic acids being mentioned. The sulphur dioxide combines with the organic compound, precipitating an insoluble salt which is removed and heated, liberating sulphur dioxide and redissolving the salt.

Oxidation of Sulphur Dioxide

During the process of absorption and regeneration of sulphur dioxide from gases a varying fraction of the dissolved gas becomes oxidised to sulphur trioxide. Two reactions are involved:—

(a) Air oxidation. $2SO_2 + O_2 = 2SO_3$ ... ... (1)

(b) Autoxidation. $3SO_2 = \frac{1}{2}S_2 + 2SO_3$ ... ... (2)

Reaction (1) is caused by oxygen in the original gases or by entrainment of air in the absorbing solutions. Reaction (2) is affected catalytically by the presence of various substances, *e.g.*, arsenious oxide and reduced sulphur compounds. The sulphur is not precipitated in the free form but exists as thionic and thiosulphuric acids, which accumulate in the solution and accelerate the reaction. If the concentration of these acids exceeds a certain value they begin to decompose, increasing the sulphate content of the solution and liberating free sulphur—factors which accelerate the autoxidation. Under normal conditions about 1 to 2 per cent. of the original sulphur dioxide content becomes oxidised. It has been found that the presence of the sulphate has deleterious effects in all the absorbing processes in use and various methods have been developed for the removal of the accumulated sulphate from the absorbing solutions.

An account of what was probably the first commercial application of basic aluminium sulphates as absorbents for sulphur dioxide has been given by Dr. M. P. Applebey.[12, 23]

It may be proved that the capacity of an aqueous liquid for dissolving sulphur dioxide at any given pressure is inversely proportional to the square of the hydrogen ion concentration. Dissolution of sulphur dioxide in water gives rise to a rapid increase in the hydrogen ion concentration and further solution soon ceases. If the solution is made alkaline no pronounced rise in the hydrogen ion concentration occurs and large quantities of sulphur dioxide may be dissolved, but regeneration of the gas by heating becomes almost impossible. Now the whole success of an absorbent depends upon easy regeneration of the sulphur dioxide and it is an obvious deduction that the absorbent must be buffered in such a way that large quantities of sulphur dioxide may be absorbed without any pronounced rise in the hydrogen ion concentration. Calculations have shown that this may be obtained in a solution buffered at a pH of about 3.5. Solutions with a

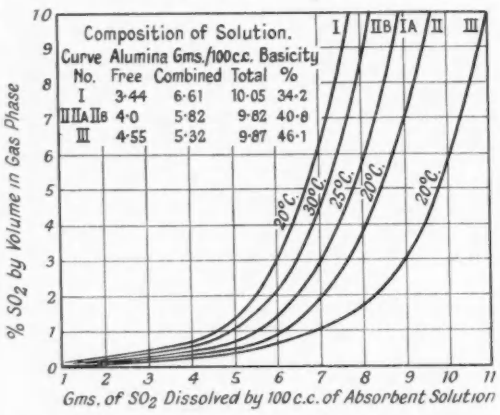

Fig. 1. Absorbing capacities of solutions of basic aluminium sulphates, showing the effects of varying degrees of basicity and of temperature (Applebey).

higher pH will not give easy regeneration and will tend to dissolve other gases, *e.g.*, carbon dioxide, while those with a lower pH will not dissolve sulphur dioxide. Solutions with the required buffer effect may be divided into two classes: (a) solutions of strong bases neutralised by acids with a dissociation constant of $10^{-3.5}$, or (b) solutions containing free bases having dissociation constants of $10^{-10.5}$. Sodium citrate solutions are examples of the first group and basic aluminium sulphates of the second group.

For commercial use the selected solvent must be cheap and easily available, considerations which lead finally to the choice of basic aluminium sulphates. The alumina is obtained in a stable solution by the device of using a soluble basic salt. The absorbent solution is prepared by precipitating gypsum from a solution of aluminium sulphate by means of ground limestone. The recommended composition of this solution is 9 to 10 gms. total alumina per 100 c.c., the amount of limestone used being calculated to precipitate as gypsum about 40 per cent. of the sulphur trioxide originally present in the aluminium sulphate, this solution being then described as 40 per cent. basic. The values may be varied, but the compositions specified have been found to be possessed of good absorbing powers coupled with a high degree of stability. Phosphoric acid is also added as a stabiliser, the concentration being maintained at approximately 0.6 gms. phosphorus pentoxide per 100 c.c. of solution. The pH value of these basic aluminium sulphate solutions remains very constant at 3.5 over a wide range of concentration and basicity. Fig. 1 shows the solubility of sulphur dioxide in such solutions. Two facts may be noted, the high solubility values increasing with the basicity of the solutions, and the marked reduction in solubility with increase in temperature, factors leading to easy regeneration of the sulphur dioxide. Fig. 2 shows the boiling points of solutions containing varying quantities of sulphur dioxide; the low temperatures required for the evolution of the gas may be noted.

Considerable difficulties were at first experienced in the use of these solutions owing to the precipitation, under certain specific conditions, of various solid compounds, very precise attention being necessary in the operation of the process to prevent their formation. Four different solid compounds may precipitate from the solutions, but only two of these are of practical importance. The "insoluble precipitate," $Al_2O_3.SO_3.3\frac{1}{2}H_2O$ forms on continual boiling of the solution, being removed only by treatment with fairly concentrated sulphuric acid. Certain inhibitors, glycerin and phosphoric acid, have been found useful, but adequate control of the regeneration process is the most important factor in preventing the formation of this precipitate. For example, a "film boiler" should be employed to prevent any portion of the liquid being maintained at the high temperatures for any long period. No pockets should be available in which crystal nuclei may collect, and regulated stripping

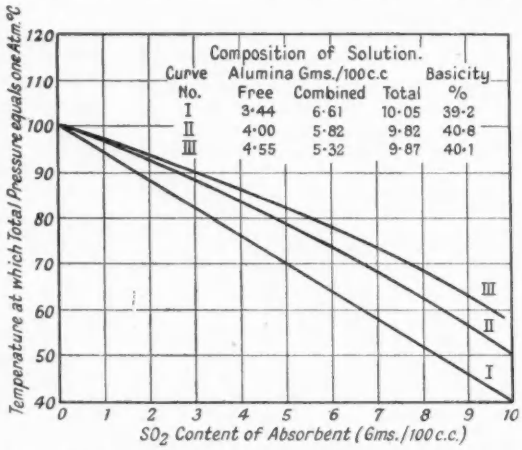

Fig. 2. Regeneration of sulphur dioxide from solutions of basic aluminium sulphates. Note the variation of the boiling points of solutions with variation in the degree of their basicity (Applebey).

of the gases should be practised. The "alkali precipitate," $3Al_2O_3.5SO_3.Na(K)_2O$, is slowly deposited as a scale on boiling if alkali salts are present. The employment of alkali-free materials and the use of limestone and not soda in the preparation of the absorbing solution will go far to eliminate this trouble. Any accumulation of scale that may form will be removed at intervals by washing with sulphuric acid.

Any accumulation of sulphate leads to a serious decrease in the buffering powers of the solution. Certain inhibitors have been used in the solution and of these methylene blue has proved most successful. The loss of this reagent on tower packings and on the gypsum filter cake is, however, much too high for economical working. Eventually it was discovered that the sulphate could be removed by the process employed in the actual preparation of the solution. Gypsum is precipitated by the addition of limestone to a portion of the regenerated solution, the precipitate filtered and the solution returned to the absorbers. The precipitated sulphate is washed free of alumina by means of a condensate containing sulphur dioxide obtained from a gas cooling tower.

This process was first employed on a commercial scale at the Imatra smelter of the Outokumpu O.Y. in Finland. In the general scheme shown in Fig. 3 three or four absorption towers were arranged in series, the solution being made to pass through these in counter-current to the gas-flow. The heat of absorption of sulphur dioxide causes an appreciable rise in the temperature of the solution in each tower, pipe coolers being inserted between each of the absorbers to maintain the absorption capacity of the liquid as high as possible. From the towers the liquor is pumped through a heat-exchanger in which it is heated by interchange with the regenerated solution. It then enters a packed regeneration tower down which it flows counter-current to a mixture of steam and sulphur dioxide. From the base of the regeneration tower it flows to an indirect steam heater in which the

temperature of the solution is raised to about 100° C., regeneration of the sulphur dioxide being very rapid at this temperature. Steam and sulphur dioxide pass up through the regeneration tower where some of the latent heat of the steam is utilised in stripping the incoming liquor. From the steam heater the solution, flowing back through the heat-exchanger, is pumped through coolers to the stock tanks, from which it is withdrawn and returned to the absorbers again. A certain definite fraction of the liquid is taken from the cycle and fed to an agitator to which limestone slurry is added in definite proportions. Gypsum is precipitated and the filtered solution is returned to the stock tanks. The sulphur dioxide, saturated with water vapour, leaves the regeneration tower at a temperature of 80° C. and, passing to a packed tower, is cooled by direct contact with circulating water. The condensate from this tower is used for washing the filter cake in the sulphate removal process. The sulphur dioxide then passes to the liquefaction plant.

The plant at Imatra, placed in commission in the spring of 1936, was designed to produce 52 tons of liquid sulphur dioxide per day from copper converter gases carrying about 5 per cent. sulphur dioxide. The experimental plant of I.C.I., Ltd., has a capacity of 20 tons of liquid sulphur dioxide per day. As an alternative to liquefaction the concentrated sulphur dioxide gases may be treated in a small reduction plant with a daily capacity of 5 to 6 tons of elementary sulphur.

The Consolidated Mining and Smelting Co. of Canada, Ltd., already cited, were the pioneers in the use of ammonia as an absorbent for sulphur dioxide.[1] In the original flow-sheet the process was very simple. The smelter gases were passed through scrubbing towers down which the solution of ammonia flowed counter-current to the gases. Absorption of sulphur dioxide was continued until a strong solution was formed consisting mainly of ammonium bisulphite, with small amounts of normal sulphite. The solution was then withdrawn and treated with sulphuric acid, liberating pure sulphur dioxide and forming ammonium sulphate, which was then sent to the fertiliser plant. The process could be applied with equal success to the treatment of lead smelter gases containing only about ½ to 1 per cent. sulphur dioxide. The process laboured under a serious handicap in that it was dependent upon a satisfactory market for the ammonium sulphate produced. This difficulty has been overcome by the use of a modified process devised by the American Smelting and Refining Co. at Garfield, Utah, but fully developed for commercial application in Canada. According to the patent specification[25] the absorbing solution contains ammonium bisulphite and sulphite together with some ammonium sulphate. The concentrates of these various salts are maintained at such value that the solution is practically saturated with respect to ammonium sulphate at the absorption temperature, but not saturated with respect to the other salts present. After evolution of the sulphur dioxide, the solution is cooled sufficiently to crystallise controlled amounts of the sulphate. On removal of the precipitated material the solution is made up to the original concentration by the addition of ammonia and water, the ammonia becoming quickly transformed to sulphite by absorption of sulphur dioxide. The modified process thus makes use of an absorbing solution which is maintained in continuous circulation, the accumulated sulphate being removed from a definite fraction of the solution in each cycle. Any increase in sulphate content leads rapidly to a precipitation of the crystalline compound, causing blocking of the pipes and conduits and reduced efficiency of the process.

It is essential that the solution should be saturated with sulphate but unsaturated with respect to the other salts, so that during any cycle the sulphate formed by oxidation, and consequently in excess of the predetermined concentration, may be removed by passing the hot solution from the regeneration step through a crystalliser maintained at a lower temperature. An amount of water is removed by evaporation sufficient to cause the sulphate to be precipitated in amounts equal to those formed by oxidation at other points of the system. The process may be practised in a solution in which the total sulphate is maintained at a much smaller value by replacing part of it by diammonium phosphate.

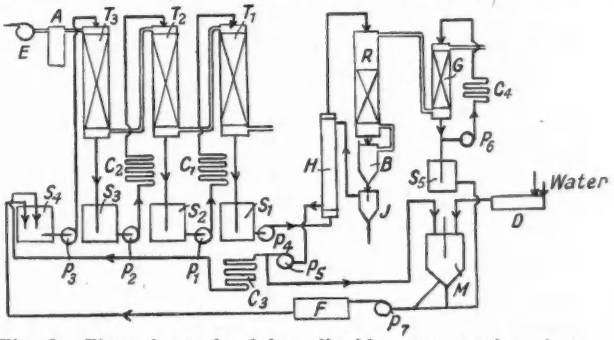

Fig. 3. Flow-sheet of sulphur dioxide concentration plant for use in conjunction with basic aluminium sulphate solutions with gas flow counter-current to solution flow T_1—T_3. Absorption towers ; C_1—C_3. Liquor coolers ; P_1—P_5. Liquor pumps ; A. Spray arrestor ; E. Gas exhauster ; S_1—S_4. Stock tanks ; H. Heat exchanger ; R. Regeneration tower ; B. Regeneration boiler ; J. Catch pot ; D. Limestone slurry mixer ; M. Mixing vessel ; P_7. Filter pump ; F. Filter press ; G. Gas cooling tower ; C_4. Circulating water cooler ; S_5. Wash water tank ; P_6. Circulating water pump (Applebey).

A brief description of the process shown in Fig. 4 is as follows :—Mixed gases from the smelter enter the base of the absorption tower A, and passing out at the top are fed to the base of a second tower B, from which they emerge substantially free of sulphur dioxide. The absorption of sulphur dioxide in a solution of ammonium sulphite may be represented as :—

$$(NH_4)_2.SO_3 + SO_2 + H_2O = 2NH_4.HSO_3$$

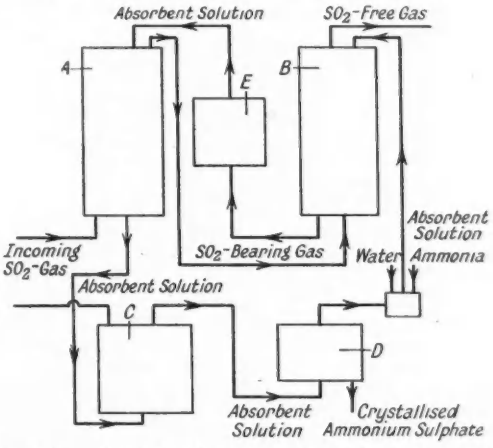

Fig. 4. Flow-sheet of absorption plant of the Consolidated Mining and Smelting Co. (B.P. 489,745).

The absorption solution, containing ammonium sulphite and bisulphite, at a temperature of less than 50° C., is pumped to the top of tower B, down which it flows counter-current to the gases. From tower B the solution passes through a cooler E, in which the temperature is lowered to less than 50° C., and is then pumped to the top of tower A. In the solution, withdrawn from tower A, practically all the ammonia has been converted to bisulphite. In the regenerator tower C the temperature is raised to 110° C., the boiling point of the solution at the prevailing atmospheric pressure. The sulphur dioxide is regenerated and a corresponding amount of normal ammonium sulphite is reformed. Under normal operating conditions, concentrations of the various salts in the solution are maintained so that the sulphate which forms during the absorption period is sufficient to bring the total sulphate content to the saturation value at 110° C. From the regeneration tower the solution passes to

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Softening Point of Glass

Meeting of the Society of Glass Technology

THE 208th ordinary general meeting of the Society of Glass Technology was held in Sheffield on Wednesday last week, the President, Dr. S. B. Bagley, being in the chair. Fifteen new members were elected, two for collective membership and thirteen for ordinary membership. The election of three new fellows was also announced.

A paper on "The Softening Point of Glass," by Dr. J. T. Littleton (Corning Glass Works, U.S.A.), was presented by Professor W. E. S. Turner. Two definitions of softening point were at present in use. The definition by the author was that temperature at which a fibre of glass, 9.25 inches long, of a diameter between 0.55 and 0.75 mm., suspended vertically in a furnace of specified characteristics, will elongate under its own weight at the rate of 1 mm. per minute. Under these conditions such a rate of extension takes place when the glass has a viscosity of $10^{7.6}$ poises. The second definition was that agreed on by the Society of Glass Technology and the Deutsche Glastechnische Gesellschaft, and was the maximum point reached on the complete thermal expansion curve of a glass. Again this point was dependent on the experimental conditions, and the apparatus employed had to be standardised before a definite viscosity value could be allocated to the point so determined.

The two methods were then described and the results obtained by them compared. The fibre-extension method was claimed to give results precise to better than one degree, whereas the interferometer method was not so precise. The latter method was based on the measurement of a temperature at which an effect having no magnitude occurred, whereas the fibre-extension depended on measuring the temperature at which the magnitude of the effect had a definite value. Softening-point determinations were a rapid and reliable means of ascertaining whether any variation in the characteristics of a glass had occurred. The fibre-extension method had been in use at Corning for over thirty years and during the last few years about ten thousand measurements a year had been made.

Standard Discs

Dr. E. J. Gooding, of the Rockware Glass Syndicate, Ltd., Greenford, Middlesex, then presented a paper on "Standard Discs in the Strain Testing of Glass." Glass discs with standardised degrees of strain (described shortly as standard strain-discs) had been used at eleven bottle factories and one other glass factory, and the results and comments of the observers were correlated. Four different types of strain-viewer had been used, and a large variety of glassware had been examined. The method was most easily employed in conjunction with a strain-viewer which had a large, uniformly illuminated field of view, with uniform polarisation over a relatively large area. The strain disc method of comparison was simple and trustworthy, and good agreement between different observers was obtained. The discs were not particularly suitable for use with amber or dark green bottles unless a suitable colour tint plate could be superimposed on them. Only about 1.5 per cent. of the ware examined had a strain grading greater than three discs.

Chemical Matters in Parliament

Nyasaland Bauxite

IN the House of Commons last week, Mr. Hall, Under-Secretary for the Colonies, in a written reply to Mr. Creech Jones, said: "The Anglo-American Corporation of South Africa, which holds an exclusive prospecting licence from the Government of Nyasaland, has proved the existence of commercial deposits of bauxite on Mlanje mountain. The corporation is now actively investigating the possibility of exploiting these deposits, but there are many difficulties to be overcome."

Oil from Coal

In a written reply to Mr. Craven Ellis, Mr. D. Grenfell stated that he had received a most valuable report on the Fischer-Tropsch and similar synthetic processes for producing oil from coal from a committee under the chairmanship of Sir W. Jowitt. The other committees investigating the subject had also all submitted their reports, which were under consideration.

Shale Oil and Cement

Mr. Vernon Bartlett asked the Secretary for Petroleum whether he could yet report on the value of oil and cement to be obtained from shale at Kilve and East Quantoxhead in Somerset.

Mr. Geofirey Lloyd replied that an investigation of these oil shales had recently been carried out by the Department of Scientific and Industrial Research, but it would not be in the public interest to make a statement about the results. He would be glad, however, to discuss the matter with the hon. Member.

British Oil Refiners

Mr. De la Bère asked the Secretary for Petroleum whether in the national interest, he would take definite steps to safeguard British oil refiners by placing one or more of their representatives on the Petroleum Board, having regard to the necessity for economy in tanker space.

Mr. Lloyd: "The Petroleum Board and the Lubricating Oil Pool already include representatives of concerns engaged in the refining industry in this country."

Mr. De la Bère: "Can my hon. Friend give me an assurance that the home industry will not be penalised for the benefit of overseas refiners?"

Mr. Lloyd gave the required assurance and arranged to have a word with Mr. De la Bère afterwards.

Glycerine

Mr. Wootton-Davies asked the Minister of Transport, in view of his recommendation to motorists to adopt well-known methods of protecting cars from frost, whether glycerine was available for the purpose, this being the best-known method.

Lieut.-Col. Moore-Brabazon, replying, said that there were other means of protecting vehicles against the effects of frost than the use of glycerine; he was in communication with the Minister of Supply with a view to sufficient anti-freeze material being made available. He hoped shortly to issue further advice to the public on the subject.

Mr. Wootton-Davies further asked the Minister of Supply the technical and medicinal purposes for which glycerine might or might not be used. In a written reply Mr. Harold Macmillan stated that the glycerine position was being carefully watched by his Ministry and steps had been taken to conserve supplies. An investigation of the uses to which glycerine is put had been made and users had been advised as to possible substitutes, for the supply of which some arrangements had been instituted. It was not possible to give a detailed list of the purposes for which glycerine is used; but they fell into three main categories: (1) For the manufacture of products for Service use and for export, the demands for which are supplied in full; (2) Other uses of national importance, including technical and medicinal uses, which have been allotted a generous quota, the total amount allowed being approximately two-thirds of the pre-war consumption; and (3) Uses of lesser importance, where an effort has been made to eliminate the use of glycerine gradually and especially where is has been possible to find substitutes and to make them available.

Personal Notes

DR. R. A. MOTT has been appointed lecturer on Coking Processes in the Department of Fuel Technology at Sheffield University.

CAPTAIN OLIVER LYTTELTON, President of the Board of Trade, was returned unopposed on Tuesday as M.P. for Aldershot.

MR. R. W. SKIPWITH has resigned from the board of the Zinc Corporation, and MR. F. A. CREW has been appointed a director in his place.

MR. GORDON ROBBINS, Deputy Chairman of Benn Brothers, Limited, proprietors of THE CHEMICAL AGE, has been appointed treasurer of the Newspaper Press Fund.

MR. WILLIAM B. HUTTON, a director of Numire, Ltd., oil importers and accessory factors, St. Andrew's Street, Dundee, has been co-opted a member of Newport (Fife) Town Council.

DR. D. H. PEACOCK, Professor of Chemistry, University of Rangoon, and Special Chemical Adviser (Customs) to the Government of Burma, is retiring from the service of the Government of Burma.

MR. GERARD SPENCER SUMMERS, a prominent figure in the steel industry, is the prospective Conservative candidate for Northampton, to fill the vacancy brought about by the of Sir Mervyn Manningham-Buller.

SIR WILLIAM CLARE LEES, managing director of the Bleachers' Association, Ltd., and MR. FRANK HOPKINSON have been appointed to the Executive Committee of the India Section of the Manchester Chamber of Commerce.

OBITUARY

MR. C. R. H. SELLECK, for many years manager for the Dartmoor China Clay Co., died last week at his home at Shaugh, near Plympton, at the age of 81.

MR. E. A. GRENQUIST, research chemical engineer to the Celluloid Corporation, Newark, New Jersey, died last month at the age of 41. Mr. Grenquist was a native of Abo in Finland, and fought in the Finnish War of Independence in 1918. He went to the U.S.A. in 1924, becoming an American citizen in 1929. He was known in this country as a member of the Institution of the Rubber Industry and was an authority on cellulose acetate and on the dispersion of pigments in rubber.

MR. CHARLES LONGUET HIGGINS, a well-known Widnes research chemist, has died at Liverpool, aged 81. He served for 50 years with the United Alkali Company and Imperial Chemical Industries, first at the old Muspratt Works and later in the Central Laboratory. At Muspratt's, Mr. Higgins was specially associated with the production of chlorates, first by the magnesia process, which in itself provided a first-class training in industrial chemistry, while later he employed his knowledge and experience of chemical chlorate on the production of electrolytic chlorate, and subsequently on the development of the mercury cell.

MR. ERNEST FREDERICK STEPHEN LANG, of Bowdon, Cheshire, who died at Torquay on November 21, aged 73, was a metallurgist and engineer of wide experience, being known as an authority on the melting of steel in Siemens open-hearth furnaces and the desulphurising of steel. He joined the firm of Beyer, Peacock and Co., Ltd., locomotive builders, in 1885, and was technical engineer from 1906 to 1931, being in charge of steel foundry control, of the analysis and testing of construction materials, and of metallurgical research. He became a Fellow of the Chemical Society in 1899, but allowed his membership to lapse; he was elected a Member of the Institution of Mechanical Engineers in 1907 and was also an Associate Member of the Institution of Civil Engineers.

New Control Orders

Protection of Glass in Factories

THE Minister of Labour and National Service has made an Order requiring occupiers of factories in which more than 250 persons are employed to provide and maintain safeguards (by way of fencing, the use of alternative materials or otherwise) to afford protection for the employee against risk from injury caused by broken glass from windows, skylights and internal partitions. The Order provides that the occupier is to have regard to any circulars which may from time to time be issued by the Minister for the guidance of occupiers of factories to which the Order applies. Such a circular dated November 21 has been issued. Copies of the Order which is called the Factories (Glass Protection) Order, 1940, and of the circular can be purchased, price 1d. each, through any bookseller or direct from H.M. Stationery Office.

The factory occupier can apply to the Ministry for exemption from the Order on the ground that the persons employed in the factory are not employed in services essential for the defence of the realm or the efficient prosecution of the war or essential to the life of the community.

Advice on Protective Methods

The circular now issued advises factory occupiers on the best methods of meeting the dangers of surprise attacks from the air, having regard to the need for the admission of daylight and the preservation of the black-out, and also to the availability of materials. It is pointed out that there is no need to alter existing arrangements if these are effective. The methods recommended include replacement of the glass by non-splintering materials, protection with fabric bitumen treatment, and protection with wire netting or expanded metal. Precautions must be taken not to upset any scheme of camouflage by external protection, and special care is necessary to see that both the initial workmanship and the maintenance of the protective material are adequate.

British Chemical Prices

Market Reports

FAIR and steady conditions have been maintained in the industrial chemical market during the past week. Whilst active interest is displayed generally, movements are mostly confined to materials in regular call and which are already covered in many cases by contracts. Consumers wishing to place their forward requirements are meeting with spot offers only or with offers covering short periods. Among the potash products there is a good call for caustic, carbonate and permanganate. Formaldehyde, acetone and acetic acid are all moving well with a steady demand for lead oxides, convention prices for which remain unchanged. In regard to prices generally values are firm with a distinct higher tendency.

MANCHESTER.—The soda products and most of the other leading heavy chemicals are attracting a fair amount of interest on the Manchester market, more especially against contract commitments, delivery specifications this week having covered good quantities in the aggregate. Values are mostly firm, with the tendency towards higher levels in a number of instances. The feature of the by-products section is the pronounced strength of solvent naphtha and the xylols, whilst most other descriptions are steady. Exceptionally an easier trend has developed in the carbolic acid market, both in crude and crystals.

GLASGOW.—Business in general chemicals has been rather quiet during the week, both for home trade and export. Prices generally continue very firm at about previous figures, and Borax has been increased by £3 per ton, and Boric Acid by £5 per ton, to take effect from November 27.

Price Changes

Borax, Commercial.—Granulated, £26; crystals, £27; powdered, £27 10s.; extra fine powder, £28 10s.; B.P. crystals, £35; powdered, £35 10s.; extra fine, £36 10s. per ton for ton lots, in free 1-cwt. bags, carriage paid in Great Britain. Borax Glass, lump, £73; powder, £74 per ton in tin-lined cases for home trade only, packages free, carriage paid.

Boric Acid.—Commercial, granulated, £42 10s.; crystals, £43 10s.; powdered, £44 10s.; extra fine powder, £46 10s.; large flakes, £55; B.P. crystals, £51 10s.; powdered, £52 10s.; extra fine powdered, £54 10s. per ton for ton lots in free 1-cwt. bags, carriage paid in Great Britain.

Carbolic Acid.—Crystals, 9¾d. to 10¾d. per lb.; Crude, 60's 3s. 6d. to 4s. 2d., according to specification. MANCHESTER: Crystals, 10¼d. per lb., d/d; crude, 3s. 6d. to 3s. 9d., naked at works.

Sodium Phosphate.—Di-sodium, £17 per ton, delivered, for ton lots. Tri-sodium, £22 per ton d/d for ton lots.

General News——From Week to Week

THE INTERNATIONAL TIN COMMITTEE meeting, which had been fixed for November 26, has been postponed to a date that will be announced later. The postponement is in order to allow the attendance of the Dutch delegation's representative, Mr. Van den Broek.

DETAILS OF ANALYSES, made by F. G. H. Tate and H. Kenneth Whalley, of over 300 samples of tobacco ash are published in the current issue of *The Analyst*. Statistical treatment of the results demonstrates that a method of identifying the source of tobacco, with a high probability of success, may be based on analysis of the ash.

MR. WILLIAM TONG, chairman and managing director of Kirklees, Ltd., laid stress, at the recent annual meeting, on the importance of rayon in the country's economic war effort. He added that, in viscose rayon yarn, approximately 15 per cent. only of the total cost of the finished product was represented by imported raw materials.

THE FOLLOWING DECISION regarding the liability to purchase tax of certain articles is among those published as supplementary to those already given in Notice No. 78 by the Commissioners of Customs and Excise. Items which are taxable when put up for medicinal, veterinary or toilet use, but are not otherwise taxable, include: Ammoniated glycyrrhizin; asparagin; catechu; catechu black; cudbear; iron; lead monoxide; litmus; mercury; methyl chloride; orchil; sulphurous acid. It should be also noted that the item "Ammonium Salts" does not include ichthammol which is taxable. (See Notice 78, Class 19(1)(a)).

IN A COMMUNICATION to the *J. Soc. Dyers and Colourists* (1940, *11*, 56, 473), C. L. Bird has proved that the constitution of Trilon A (of the I.G.) is the sodium salt of $\alpha : \alpha' : \alpha''$-trimethylamine tricarboxylic acid, and that Trilon B is the sodium salt of ethylene-bis-(iminodiacetic) acid. The method employed was the comparison of the free acids of the two compounds with the free acids obtained from purified Trilon A and B. Experiments also showed that Trilon B possessed a very good protective action for mordant dyes on wool which were sensitive to iron, and Trilon A much less.

USERS OF COATED PAPER for packing, etc., will be interested to hear that, as a result of pressure brought to bear on the authorities, coated papers and coated boards made from home-produced raw material, such as straw, rags, waste paper, etc., can be used for many purposes which recent Orders have prohibited. The paper can now be used for wrapping or packing certain articles, collapsible tubes can again have cartons, and labels containing advertising matter can be of a larger size, in accordance with the Control of Paper (No. 28) Order, November, 1940, H.M.S.O., 3d. There are good stocks of the paper in the country, much of it being of reasonable quality, though not quite so good as paper previously used, but far better than anything that was produced in the last war.

Foreign News

IMPORTS FROM SOUTHERN RHODESIA of chemicals, drugs, etc., to the end of last July were valued at £372,927 (last year £271,158).

IT IS ANNOUNCED FROM JERUSALEM that Palestine potash and bromine, which was exported via Haifa, may now reach Europe via Basra.

THE NEWFOUNDLAND IMPORT DUTY on perfumes, essences and toilet preparations of all kinds containing alcohol has been increased from 55 per cent. *ad valorem* to 65 per cent.

CHILEAN IODINE OUTPUT, a by-product of two nitrate plants, amounted to 382,069 kg. in the first six months of 1940, compared with 25,550 kg. in the same period of 1939. Iodine exports totalled 350,009 kg. in the first half of 1940, compared with 180,950 kg. in the corresponding period of 1939.

ACCORDING TO AN OFFICIAL CABLE, the Malayan Information Agency reports that the local output of tin and tin in ore at 75.5 per cent. in October was as follows: Federated Malay States, 5368 tons; Unfederated States, 231 tons; Straits Settlements, 5 tons; making a total of 5604 tons.

EXPORTS OF POTASH AND BROMINE from Palestine have more than doubled since the war began, according to a correspondent of *The Economist*, and now amount to the value of almost £1,000,000.

THE CRYOLITE MINES OF GREENLAND are now under the protection of the United States Navy. Greenland is the only known source of this mineral in the world, and the cryolite is used principally in the extraction of aluminium from bauxite, and also in glass manufacture.

THE AMERICAN MAGNESIUM CORPORATION plant is being trebled in order to meet the increasing needs of national defence, and before long all departments are expected to work on three shifts per day. The Corporation's magnesium powder plant at Cleveland will soon, it is stated, be turning out over ten times the quantity produced last year.

A SECOND PLANT for the manufacture of nylon yarn is to be built by E. I. du Pont de Nemours and Co., Inc., at Martinsville, Virginia. The plant is expected to come into production late in 1941, and be in full operation in the spring of 1942. The plant will cost approximately $11,000,000, and when completed will employ about 750 persons.

THE NATIONAL ASSOCIATION OF WASTE MATERIAL DEALERS, Inc., New York, has just issued a new Standard Classification for Old Metals. It deals with 73 items as compared with 36 in the last edition. The new items refer to aluminium scrap of different sorts, to nickel and its alloys, especially monel and ferro-nickel, to stainless steel and to Edison batteries.

NEWS OF A GRACEFUL TRIBUTE on the part of Russian scientists to the late Sir J. J. Thomson is reported by his son, Dr. G. P. Thomson, in a letter to *The Times*. Dr. Thomson has heard from Mrs. Kapitza, in Moscow, that her husband delivered an address on the work of Sir J. J. Thomson to a joint meeting of the U.S.S.R. Academy of Sciences and the University of Moscow on September 20. Professor Kapitza is the well-known physicist who worked many many years at Cambridge and is now Director of the Institute for Physical Problems in Moscow.

A 100-TON MATERIALS-TESTING MACHINE, so powerful that it can bend two parallel 12-inch steel I-beams, yet so accurately controlled that it can crack a nut without crushing the kernel, has been built by American Machine and Metals, Inc., East Moline, Illinois. It is 34 feet high, 21 feet wide, and 24.5 feet from front to back. The transverse table is 8 feet wide. Not only is the machine one of the largest in the world, but it is said to be among the most accurate. Though it can exert a maximum of 700,000 lb. pressure, the mechanism has recorded a maximum error of 0.06 per cent.

Forthcoming Events

A JOINT MEETING OF THE Food Group of the Society of Chemical Industry with the Society of Public Analysts and Other Analytical Chemists will be held on December 4, in the Rooms of the Chemical Society, Burlington House, Piccadilly, at 11 a.m. This will take the form of a short symposium on the subject of "Cheese: Some Recent Chemical and Physico-Chemical Findings," and after a brief introduction by Professor H. D. Kay, papers will be given by members of the staff of the National Institute for Research in Dairying.

A MEETING OF THE Manchester Section of the S.C.I. will be held at the Grand Hotel, Aytoun Street, Manchester, on December 6, at 1.30 p.m., when a lecture on Vitamin-B_1 will be delivered by Professor A. R. Todd, D.Sc., D.Phil.

A MEETING OF THE Birmingham and Midland Section of the S.C.I. has been arranged to take place on December 12, in the Birmingham Chamber of Commerce Buildings, New Street, Birmingham, at 4.30 p.m. Mr. E. Taylor-Austin, F.I.C., of the British Cast Iron Research Association, will read a paper entitled "The Application of the New Lovibond Tintometer to Colorimetric Analysis." The lecture will be illustrated by slides.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

XELEX PRODUCTS, LTD., London, W., manufacturers of raw plastic material. (M., 30/11/40.) November 6, £625 debs., part of a series already registered.

County Court Judgments

HARRISON, R. V. (male), Harvestex Mills, Ebley, Glos., (C.C.J., 30/11/40.) Manufacturer of artificial manure. £23 10s. October 8.

LANDORE ZINC, LTD., Landore Zinc Works, Landore, Swansea. (C.C.J., 30/11/40.) Zinc manufacturers. £27 17s. 5d. September 9.

Private Meeting

(Inclusion under this heading does not necessarily imply failure. Many private meetings are called in order that the debtor may consult his creditors as to his position, without any suggestion of insolvency).

BELVEDERE CHEMICAL CO., LTD. (P.M., 30/11/40.) Meeting of creditors at 39-51 Highgate Road, London, N.W.5, on Wednesday, November 27, at 12 noon. A secured creditor is required (unless he surrenders his security) to lodge at the registered office of the Company before the meeting a statement giving particulars of his security, the date when it was given, and the value at which it is assessed.

Company News

The Sanitas Co., Ltd., announce a net profit to March 31 last of £151,073 (last year, £92,114).

Aspro, Ltd., have declared a half-yearly dividend, less tax at 9s. 6d., on preference stock, payable December 31.

The British Oxygen Co., Ltd., report dividends for the half-year to December 31, 1940, on the 6½ per cent. and 5 per cent. cumulative preference stocks, less tax at 8s. 8d.

National Fertilisers, Ltd., announce a dividend on 4½ per cent. redeemable cumulative preference shares for the half-year ending December 31, payable on January 1, 1941, less tax at 9s. 6d.

The directors of **Beechams Pills, Ltd.,** have declared a second interim dividend of 7 per cent., actual, less tax, on the deferred shares, payable December 18, on account of the year ending March 31, 1941. This makes 14 per cent. to date. Last year's final dividend was 14.81 per cent.

Imperial Smelting Corporation, Ltd., report net profit of £268,465 for the year, compared with £100,930. Full dividend on 6½ per cent. cumulative preference shares has already been paid, together with arrears of 2½ per cent.; dividend of 3½ per cent. is to be paid on the ordinary share capital.

New Companies Registered

Ottowell and Company, Limited. (364,043).—Private company. Capital, £10,000 in 10,000 shares of £1 each. Chemical manufacturers, general merchants and manufacturers, dealers in machinery, apparatus and raw materials, etc. Directors: Trafford T. Ottowell, Herbert V. T. Murray. Solicitors: W. P. Webb, 5 Verulam Buildings, W.C.1. Registered office, 1 Warwick Street, W.1.

Geigy Pharmaceutical Company, Limited. (364,035).—Private company. Capital, £5000 in 5000 shares of £1 each. Manufacturers, importers, exporters, brokers and distributors of and dealers in pharmaceutical and chemical products (*except* dyes) and particularly pharmaceutical products manufactured or supplied by J. R. Geigy, of Basle, and the Geigy Colour Co., Ltd., of Manchester. Directors: Chas. F. Gysin, Harold L. Addleshaw. Solicitors: Addleshaw, Sons and Latham, Manchester. Registered office, National Buildings, Parsonage, Manchester.

Chemical and Allied Stocks and Shares

NO very definite tendency has been observable on the Stock Exchange, but recent gains in industrial securities continued to be maintained in part, despite absence of improvement in the volume of business. British Funds and investment stocks were firm, aided by reinvestment of the proceeds of requisitioned Canadian securities. Shares of companies in the chemical and associated trades were little changed on balance, but individual features of interest were not lacking.

Imperial Chemical reacted from 29s. 3d. to 28s. 3d., but the 7 per cent. preference remained at 31s. 3d. B. Laporte were again 50s., while business in Greeff-Chemicals 5s. units was recorded at 5s. 7½d. William Blythe 3s. shares were again quoted at 5s. 3d., while elsewhere, Turner and Newall further improved in response to current market dividend estimates. British Oxygen were also favoured, and were 66s., compared with 65s. 7½d. a week ago. Among shares which are very firmly held, Johnson Matthey preference transferred at 18s. 9d. and Lawes Chemical at 7s. 6d. Dunlop Rubber were lower at 31s. 6d., and Cerebos were easier at £8¾, although Reckitt ordinary were firm at 89s.

Expectations that the interim dividend will be maintained, and attention drawn in the market to the company's varied interests, explain the further rise in Distillers from 63s. to 65s. Borax Consolidated issues were rather more active; the deferred units held last week's improvement to 26s. 10½d. On the other hand, Barry and Staines reacted from 28s. 9d. to 26s. 3d. on the reduction from 5 per cent. to 3 per cent. in the interim dividend, which had not been generally expected in the market. Michael Nairn, however, were higher at 45s. and Wall Paper Manufacturers deferred units made the better price of 19s. 6d. British Plaster Board reacted from 13s. 3d. to 12s. 9d., and British Match were 30s. 7½d. compared with 31s. 3d. a week ago. International Paint were again 70s., and Pinchin Johnson around 19s. British Industrial Plastics 2s. shares had a firmer appearance at 2s. 6d. on the improved profits for the past financial year and the maintenance of the dividend at 8 per cent. Associated Cement were easier at 60s., and few dealings were recorded among other cement manufacturers' shares. Consideration of the past year's good results maintained firmness in Tube Investments ordinary shares, which were quoted at 85s., while Stewarts and Lloyds were 40s. Dorman Long were around par, awaiting the full results and annual meeting for explanation of the lower profits. Babcock and Wilcox, however, were better at 39s., and Staveley shares steady at 42s. 6d. Following publication of Fine Cotton Spinners interim statement, textile shares had a firmer appearance.

Elsewhere, United Glass Bottle ordinary showed business at 44s. 6d., while Triplex Glass were 18s. 9d. Among other shares of glass companies, Redfern Bros. 5s. ordinary were quoted at 12s. 6d. on the good financial results and the raising of the distribution from 15 per cent. to 20 per cent. by the addition of a cash bonus. Canning Town Glass 5s. units were again around par. British Glues 4s. shares were 6s. 3d., and business in the participating preference shares took place at 26s. 6d. In other directions, Boots Drug became easier at 39s. 6d., but Timothy Whites were firmer at 19s. 9d., although Sangers reacted slightly to 18s. 9d. Lever and Unilever were lower at 23s. 9d., and the various preference shares lost a few pence as compared with a week ago. United Molasses at 21s. 6d. also failed to hold best prices recorded recently. Following last week's improved tendency, "Shell" and other leading oil shares became easier, but few important movements were shown.

(*Continued from page* 251.)

a vacuum pan or vacuum crystalliser in which the temperature is lowered to 70° C. and a predetermined amount of water removed by evaporation. The solution entering the crystalliser is saturated with respect to the sulphate and not with respect to the other salts, so that only the sulphate in excess of the amount soluble at 70° C. crystallises out and is removed. To the solution from the crystalliser sufficient water and ammonia are added to restore the concentrations to their original values. Passing through a cooler, in which the temperature is lowered to 30° C., the solution is returned to the absorbing towers.

The amount of sulphur dioxide which may be regenerated from the solution is limited by the partial pressure of the ammonia and also by the fact that large volumes of steam are evolved in the later stages, so setting an economic limit to the amount regenerated (usually between 11 and 20 per cent. of the total sulphur dioxide content). Substantially pure sulphur dioxide, saturated with water vapour, is produced, separation of the steam being effected in a condenser.

(*To be continued.*)

CLASSIFIED SECTION

NOTE: Trade announcements, other than strictly second-hand and job lines, cannot be inserted in these pages except by firms whose advertisements run in the display columns

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THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN,
219, Temple Bar House, London, E.C.4.

THE INSTITUTION OF CHEMICAL ENGINEERS. EXAMINATION, 1941.

APPLICATION forms (returnable 16th December, 1940) and particulars of the Associate-Membership Examination for 1941, together with the Memorandum on "The Training of a Chemical Engineer" may be obtained from the Hon. Registrar, Institution of Chemical Engineers, 56 Victoria Street, Westminster, London, S.W.1.

FOR SALE

(2d. per word ; minimum 18 words ; 3 or more insertions, 1½d. per word per insertion. Sixpence extra is charged when replies are addressed to box Numbers.)

1000 STRONG NEW WATERPROOF APRONS. To-day's value 5s. each. Clearing at 30s. dozen. Also Large Quantity Filter Cloths, cheap. WILSONS, Springfield Mills, Preston, Lancs. Phone 2198.

CHARCOAL, ANIMAL, and VEGETABLE, horticultural, burning, filtering, disinfecting, medicinal, insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams, "Hill-Jones, Bochurch, London." Telephone : 3285 East.

600

TRIPLE EFFECT EVAPORATOR
FOR
IMMEDIATE DISPOSAL.

We can offer the following very fine Evaporator for quick sale at most attractive price :—

TRIPLE Effect Evaporator by McNeil, with brass tubed calandrias each containing 380 tubes 3 ft. 6 in. long, 16 W.G. giving total heating surface of 1480 square feet. The tubes are 1¼ in. dia. expanded into brass tube plates 7 ft. 0 in. dia. by 1 in. thickness. The vapour portions are 7 ft. 0 in. dia. by 5 ft. 8 in. high, each arranged manholes and 3 sight windows 9 in. by 4 in. with bronze fittings. Bolted on domed covers arranged 1 ft. 4 in. vapour outlets.

The Evaporator is complete with Jet Condenser, interconnecting pipes, fittings, etc.

Further details from :—
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100 REBUILT Hydro Extractors by all leading makers from 18 in. upwards with countershafts attached and safety covers. Jacketed Steam Pans, various sizes. List on request. Seen at Randalls, Arundel Terrace, Barnes. Telephone : Riverside 2436.

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